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## **Morphology of rice grains recovered from ruins in Thailand**

by

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The present paper is a result of morphological analysis of the shape of grains recovered from the bricks collected from old temple-sites and city-walls in central Thailand. Based on our knowledge of the present day methods of brickmaking, the date of these rice grains seems to be identical with that of the bricks. The grains constitute reliable material for identifying the types of rice then cultivated.

### **I Material and method**

The bricks were collected in 1967 from twenty-two different sites shown in Fig. 1. The sites are located in the Mae Nam Chao Phraya basin, an old lowland rice cultivating area. The bricks seem to date from 6th to 18th century, A.D. For the purpose of precise measurement, only the grains in good shape were selected.

Some bricks contained as many as 50 grains each; others only one husk. No grain was found in Sample No. 10. This difference in the number of grains contained (see Table 1) may be attributed to different methods of making the bricks. The bricks containing many grains were probably made of clay mixed with rice hulls—a method still employed in Thailand. Those containing few grains were made perhaps from clay without rice hulls and the grains found in the latter were probably mixed in accidentally. In both cases the bricks bear no vestiges of being fire-baked. They were shaped, and then sun-dried.

### **II Experimental results and discussion**

Results of measurements are shown in Table 1. They show a range of 6.73-7.91 mm in length, 2.89-3.51 mm in breadth, and 2.13-2.62 in length-breadth ratio. Samples Nos. 1 and 2, possibly the oldest grains, are comparatively wide. But the relationship between the morphology and the age of the grains cannot be satisfactorily determined by our data.

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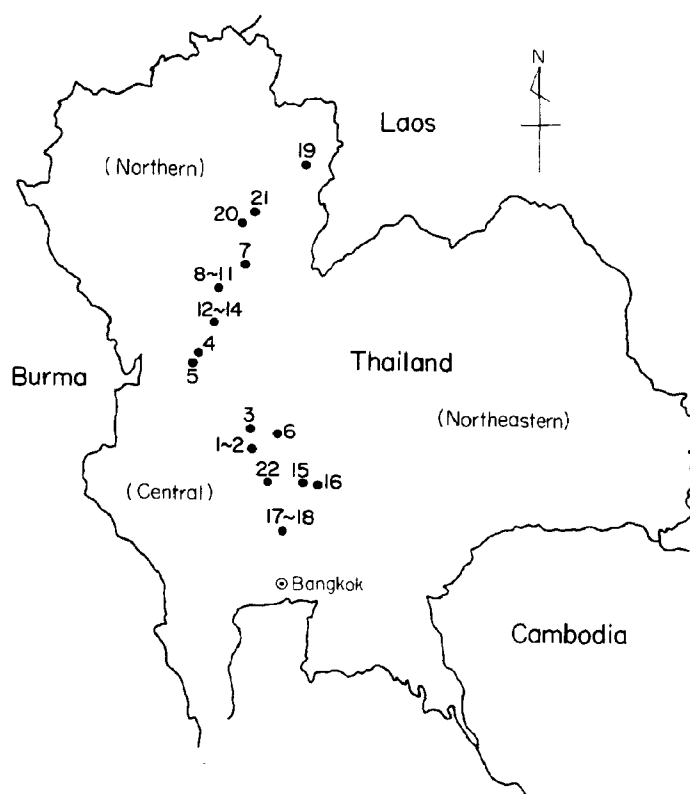


Fig. 1 Sampling sites of bricks



Photo. Grain in brick (Collection No. 16)

Rice is usually classified into three types, A, B and C. Type C is *indica*, a variety which is widely cultivated in tropical Asia. Type A is *japonica* commonly grown in the temperate zone. Type B is an intermediate type between A and C. As shown in Fig. 2, almost all varieties of rice cultivated in Thailand belong to type B or C. Only some upland varieties of rice grown by the hill people in northwestern Thailand come on the periphery of type A.\*

The results of measurements show that the majority of the grains examined belong to type A. Few exceptions were identified with the other types. We conclude that the varieties of rice cultivated in Thailand in those days differ from the present

\* A classification of cultivated rice varieties in Thailand has been proposed by several scientists. Nagamatsu (1942)<sup>5)</sup>, Cho (1960)<sup>2)</sup> and Hamada (1965)<sup>3)</sup> pointed out that most of the varieties in Thailand belong to *indica*, and Oka (1953)<sup>6)</sup> named them the "continental group" which is composed mainly of the *indica* varieties.

**Table** Main characters of old grains

No.	Sampling site	Age of sample estimated	Number of grains tested	length mm.	Grain shape breadth mm.	length/ breadth
1	Payuhakhiri	6-11 c A.D.	15	7.91 $\pm$ 0.91	3.51 $\pm$ 0.11	2.25 $\pm$ 0.09
2	Payuhakhiri	6-11 c	39	7.28 $\pm$ 0.28	3.41 $\pm$ 0.15	2.13 $\pm$ 0.10
3	Nakhon Sawan	13-14 c	50	7.45 $\pm$ 0.25	3.33 $\pm$ 0.18	2.24 $\pm$ 0.13
4	Kamphaeng Phet	ca. 14 c	3	6.73 $\pm$ 0.55	2.90 $\pm$ 0.10	2.32 $\pm$ 0.13
5	Kamphaeng Phet	ca. 14 c	30	7.01 $\pm$ 0.17	2.90 $\pm$ 0.13	2.42 $\pm$ 0.08
6	Tha Tako	6-11 c	30	7.36 $\pm$ 0.37	3.31 $\pm$ 0.20	2.22 $\pm$ 0.04
7	Uttaradit	6-11 c	1	6.70	2.90	2.31
8	Sawankhalok	14 c	50	7.29 $\pm$ 0.58	3.07 $\pm$ 0.18	2.37 $\pm$ 0.18
9	Sawankhalok	14 c	50	7.01 $\pm$ 0.13	2.99 $\pm$ 0.11	2.34 $\pm$ 0.09
10	Sawankhalok	14 c	0	—	—	—
11	Sawankhalok	14 c	15	7.31 $\pm$ 0.44	3.01 $\pm$ 0.22	2.43 $\pm$ 0.21
12	Sukhothai	13-15 c	30	7.41 $\pm$ 0.67	3.06 $\pm$ 0.28	2.42 $\pm$ 0.10
13	Sukhothai	13-15 c	30	7.01 $\pm$ 0.12	2.95 $\pm$ 0.06	2.38 $\pm$ 0.07
14	Sukhothai	13-15 c	30	7.15 $\pm$ 0.24	3.03 $\pm$ 0.16	2.36 $\pm$ 0.19
15	Lop Buri	17 c	25	7.10 $\pm$ 0.30	3.06 $\pm$ 0.26	2.32 $\pm$ 0.16
16	Lop Buri	17 c	50	6.94 $\pm$ 0.16	3.23 $\pm$ 0.16	2.15 $\pm$ 0.10
17	Ayutthaya	14-18 c	30	7.50 $\pm$ 0.38	3.13 $\pm$ 0.17	2.40 $\pm$ 0.09
18	Ayutthaya	14-18 c	30	7.06 $\pm$ 0.22	3.13 $\pm$ 0.25	2.26 $\pm$ 0.18
19	Nan	?	1	6.60	2.80	2.36
20	Phrae	?	1	7.40	2.80	2.64
21	Phrae	?	5	7.20 $\pm$ 0.25	3.00 $\pm$ 0.07	2.40 $\pm$ 0.07
22	Sing Buri	?	50	7.56 $\pm$ 0.23	2.89 $\pm$ 0.14	2.62 $\pm$ 0.12

lowland rice varieties. They show much similarity to those varieties now cultivated in the upland area of Thailand. It is to be noted, however, that the present physiological conditions of the sampling sites are unsuitable for the upland varieties.

The transition of grain type from *japonica* to *indica* in a period of only two hundred years can hardly be accepted as the result of botanical evolution. It may be attributed to a change caused by external reasons. A sudden increase of rice production for export after the Bowring Treaty of 1855 came into effect may have led to the breeding or introduction of new varieties.

In the present paper only the morphological aspects are taken up. Chemical analysis and determination of date by the  $C_{14}$  dating method are now being done to confirm our result.

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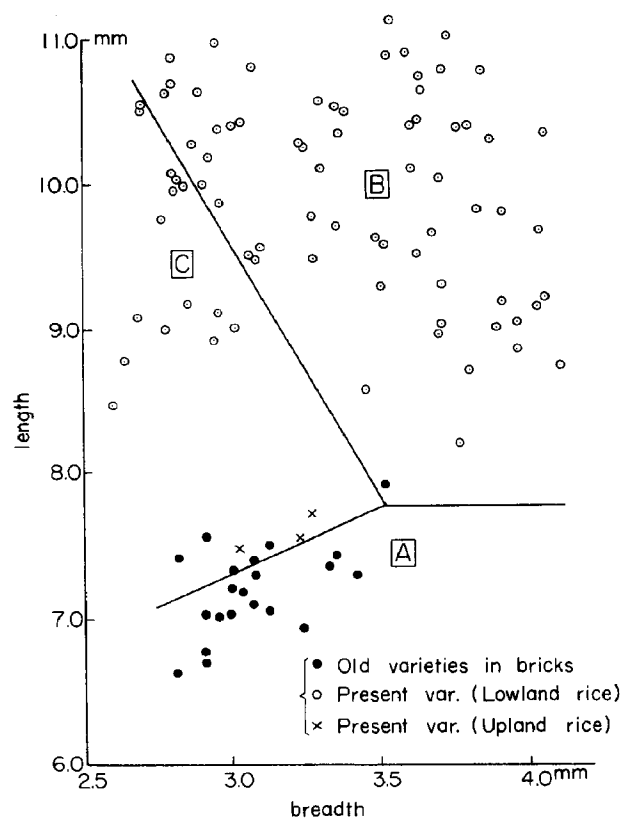


Fig. 2 Distribution of grain shape, data by Akihama (1965)<sup>1)</sup> and Watabe (1967)<sup>7)</sup> are plotted on the Matsuo's classification map (1952)<sup>4)</sup>

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